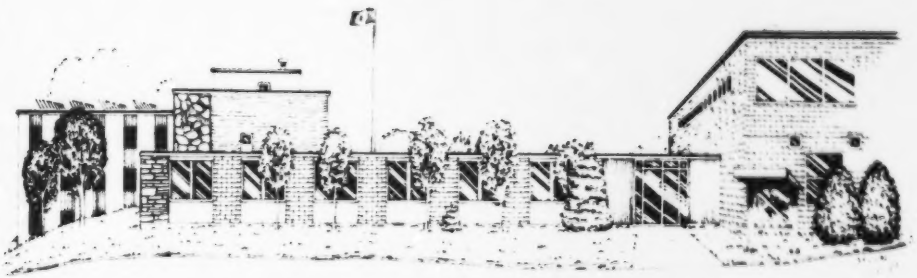
Government of Canada | Gouvernement du Canada

Canadian Forestry Service | Service canadien des forêts

PROGRAM REVIEW

1984-1985

PETAWAWA NATIONAL FORESTRY INSTITUTE



86-06179/

THE CANADIAN FORESTRY SERVICE GOVERNMENT OF CANADA

The Canadian Forestry Service is the principal source of federal expertise in forestry. Its general objective is to promote the wise management and use of Canada's forest resources for the economic, social, and environmental benefit of Canadians.

The following are the main functions of the CFS:

1. Coordination of federal policies, for the promotion of better resource management and forest industry development.
2. Provision of scientific and technological leadership in forestry through research and development.
3. Provision and analysis of national and international statistics and information as a basis for policy formulation.
4. Development and certification of codes and standards for wood product performance.
5. Protection of Canada's forests from foreign pests.
6. Fostering the potential use of the forest resource for energy.
7. Contributing to the environmental objectives of the government of Canada.

A number of federal agencies are involved in forestry programs and a Federal Forestry Sector Strategy Committee has been established to coordinate federal forestry activities. The Canadian Forestry Service has been designated the lead agency.

The Canadian Forestry Service is comprised of a headquarters unit, six forestry centres, and two national institutes. The forestry centres are responsive to regional priorities and maintain close liaison with the respective provincial government forestry departments and other clients. They also participate in, and frequently lead, national programs. The national institutes provide the focus for programs of national scope.

PROGRAM REVIEW

1984-1985

PETAWAWA NATIONAL FORESTRY INSTITUTE

Table of Contents

Foreword	1
Forest Management Systems	3
Fire Behaviour and Effects	5
Fire Equipment, Materials, and Methods	5
Fire Management Systems	6
Fire Suppression Systems	7
Forest Meteorology	7
Silviculture and Forest Productivity	8
Digital Remote Sensing	9
Forest Management Modelling	9
Technology Development - FIDS	10
Field Services and Forest Management Operations	10
Forest Genetics and Biotechnology	13
Tree Genetics and Breeding	15
National Tree Seed Centre, R&D	15
National Tree Seed Centre, Seed Bank & Services	16
Soil Microbiology and Fertility	17
Molecular Genetics and Plant Tissue Culture	17
FORSTATS	19
Forestry Data Systems	23
Communications	27
Editing and Publications	29
Information Services	30
Library	31
Public Awareness	32
Administration	33
Expenditures and Contracts	37
Publications 1984-1985	43
Staff Listing	49
Organization Chart	56

FOREWORD

The past year saw integration and change involving several programs at PNFI. The research initiatives and technical services at the Institute now encompass six major activities.

FOREST GENETICS AND BIOTECHNOLOGY - Integrates projects in tree genetics, soil microbiology, micropropagation, molecular genetics, and seed research. It also includes the client services and seed bank operations of the National Tree Seed Centre, a long-standing program with extensive international affiliations.

FOREST MANAGEMENT SYSTEMS - This program integrates projects in fire, remote sensing, meteorology, modelling, growth and yield, and FIDS to provide research and development for the formulation and demonstration of forest management systems.

NATIONAL FOREST RESOURCE STATISTICS - Widely known as FORSTATS, this program coordinates the acquisition, standardization, and publication of national statistics on the forests of Canada, and responds to client requests.

FOREST DATA SYSTEMS - Provides the expertise and computer-based systems necessary to manage data acquired through FORSTATS and the research projects at PNFI. Additionally, the program provides informatics advice and service at the CFS corporate level.

COMMUNICATIONS - Integrates activities of the library, public awareness, information, and editing and publications projects. The Institute is visited by more than 20 000 people every year. There is a Visitor Centre for the public, self-guided tours, and an extensive education project. The national repository of all scientific and technical publications of the CFS is at PNFI.

THE RESEARCH FOREST - Besides natural stands manipulated in a variety of ways for silvicultural research, the 98 km^2 Petawawa Forest contains extensive areas of plantations dating back six decades. Research plantations are a source of growth and yield data derived from cultural experiments, and they are becoming valuable for pedigreed genetic materials for micropropagation and molecular genetics studies. The forest also offers opportunities for short- and long-term testing of forest management strategies.

Some of these activities only came into effect in February 1985 and will be more fully elaborated in the next published program review.

This new structure will better enable the Institute to focus on and develop new methodologies and technologies for use in forest management. It will also facilitate the process of technology transfer through the next decade.

Dr. F.C. Pollett, Director

FOREST MANAGEMENT SYSTEMS

PROJECT PI-4

Fire Behavior and Effects

Objectives: To expand the Canadian Forest Fire Danger Rating System to yield quantitative estimates of fire behavior; to explain and model the ecological role of fire in the boreal forest and its effect on timber supply; to develop the effective use of prescribed fire in managing white and red pine.
Achievements: Three major works in forest fire danger rating were completed and issued in collaboration with fire researchers in other CFS research centres. These were 1) a revision of Fire Weather Index (FWI) mathematics, 2) the design of a new set of tables for the FWI System and, 3) compilation of a set of equations predicting fire spread rate and area growth in 14 forest types throughout Canada.

Accomplishments in the field of fire effects included 1) determining the degree to which disturbing the forest floor affects the growth of jack pine, 2) a comparison of forest floor respiration rates at various times since fire, 3) mathematics for the negative exponential and Weibull models of age-class distribution in fire-cycled forest and, 4) collection of field data on the mechanism of tree-clumping in the boreal forest after fire.

PROJECT PI-5

Fire Equipment, Materials, and Methods - Development, Standards, and Evaluation

Objectives: To give direction to agencies and industry in the standardization of forest fire control methods, equipment, and materials; to assist in the development of new forest fire fighting equipment; to promote technology transfer and information exchange among Canadian forest fire management agencies; and, to compile national statistics on forest fires.
Achievements: The project evaluated fire fighting foams, hoses, hose-couplings, pump-wetting agent injectors, polycarbonate nozzles, and fire retardant jump suits in the provinces and on site in order to assist provincial agencies and industry. Further, background material was provided to ULC for inclusion in hose and coupling standards. Assistance was provided to OMNR in their helitorch aerial

ignition program. The Valley Blazer Burnout Torch was given field trials and ULC certification recommended.
A variety of forest fire statistics was prepared and the Forest Fire Technical Information Centre maintained. PI-5 published a national equipment development publication "Smoke Signals."

There was active participation in several agencies concerned with forest fire control equipment, such as the C.I.F.F.C., the C.C.F.F.M., and the Canadian Standards Association. The project had a lead role in the Thunder Bay C.C.F.F.M. national forest fire equipment workshop.

PROJECT PI-6

Fire Management Systems

Objectives: To research develop and integrate appropriate new decision-making, computer, and remote sensing technology into the daily operations of Canadian fire management agencies; to apply centralized command and control concepts developed by the military and modern city fire departments to the Canadian forest fire situation.
Achievements: During the past year efforts have been focused on the installation of a precipitation radar in the Outaouais region and development of supporting computer software designed to continuously monitor rainfall within a large portion of the region. Considerable energy was spent in planning for the implementation of the fire management system in five fire regions of Ontario and six regions of Quebec. The fire centre in each of these regions is scheduled to receive a computer with the appropriate fire management software within the next three years. Project work in the past year also included software standardization, continued fire growth model development, and improvements in the digital radio transmission system. Work was begun on the use of artificial intelligence for improved fire control decision-making.

Principal cooperators have been the Ontario Ministry of Natural Resources, the British Columbia Ministry of Forestry, and the Société de Conservation de l'Outaouais.

PROJECT PI-7

Fire Suppression Systems

Objectives: To evaluate and report on the effectiveness and cost benefits of ground and aerial forest fire suppression systems proposed for use, and those currently used by Canadian forest fire management agencies.
Achievements: Field work continued in New Brunswick with the Dromader M-18 air tanker on evaluations of foam-generating agents. Tests were made on spruce and pine stands to determine interception by the canopy, adhesion to foliage and stems, and foam life and drainage rates.

Surveys on fire suppression methods and techniques were carried out, fire line production rate estimates were derived, and equations were formulated for use in computer simulations.

Work continued on the problem of fire hazards in plantations. Sampling was carried out in numerous districts in Ontario, and in two locations in northern New Brunswick, to develop a sampling technique and evaluation process suitable for province-wide application in evaluating hazards created by stand-tending practices and suppression requirements.

PROJECT PI-8

Forest Meteorology

Objectives: To use state-of-the-art meteorological technology in the solution of forestry problems, particularly those related to fire and forest renewal.
Achievements: The past year has seen the development of an automatic weather station, reporting by satellite, which would enhance the database for future forestry operations; the instrumentation of a major field study in forest wind modelling in order to improve fire spread calculations; a nationwide study of the relationship of weather to area burned by wildfire; a meteorological study of an escaped experimental fire; a model for the solar radiation flux in a clear-cut strip for use in white pine weevil control; FWI computations over sloping terrain, etc.; instrumentation of frost damage studies in a red pine plantation; NOAA series AVHRR enhancement for the measurement of rate of spread of forest fires; a

study of blowdown in severe winds; and, a study of post-fire regrowth using LANDSAT imagery. The first phase of a project (contract) to evaluate the use of low-cost X-band radar to measure precipitation in remote forest locations has been completed. For this purpose a network of nine automatic raingauges communicating by packet-switched UHF radio has been established in an extended pattern across the Outaouais region of Quebec.

PROJECT PI-12

Silviculture and Forest Productivity

Objectives: To determine the growth and yield of forest trees and stands; to relate stand development to silvicultural treatment and assess the economic and environmental implications; for selected commercial tree species, to determine the effects of spacing and cultural treatments; and, to develop models designed to facilitate the economic and biological evaluation of plantation management options.

Achievements: Ongoing data collection from over 300 permanent sample plots provides information useful to studies of growth and yield, stand dynamics, and response to silvicultural treatment. In the past year studies using this data have produced red pine plantation yield tables, a report on regeneration problems under a tolerant hardwood stand, and a report on the incidence of white pine weevil attack in regeneration after strip cutting.

Data collected throughout Ontario was used by project staff to study variation in wood density and to derive biomass volume equations based on diameter and height measurements. A current bibliographic reference on stand development effects of initial tree spacing was updated and published.

Current initiatives in the project are towards determining biologically based guidelines for assessing plantation establishment and growth performance. Also, a study has been carried out investigating acidification of soils under spruce and pine plantations, which may lead to further work on factors determining susceptibility to root pathogens. The general trend is towards increasing study of biological determinants of plantation productivity.

PROJECT PI-16

Digital Remote Sensing

Objectives: To research, develop, and transfer to the forestry community practical methods of extracting information on the state of Canada's forests from imaging satellite and airborne sensor systems operating in the visual, infrared, and microwave part of the spectrum.
Achievements: The project operates and manages a powerful image analysis computer system. A new "state-of-the-art" image analysis system was acquired. Other change detection approaches continue to be investigated, particularly methods for the assessment of conifer regeneration. A computer classification of airborne scanner data was successful at detecting forest areas of current spruce budworm defoliation. A cooperative investigation among PNFI, MFRC, and CCRS was initiated and data acquired.

The project is taking a lead role in developing forestry applications of high resolution MEIS (Multispectral Electro-optical Imaging Scanner). Enhancements of MEIS imagery appropriate for identifying coniferous species were developed and reported. Studies to investigate the potential for regeneration assessment and insect defoliation on a single tree basis were initiated and data acquired.

PROJECT PI-19

Forest Management Modelling

Objectives: To review, evaluate, and test or modify existing forest management models; to develop a comprehensive forest management model that can be used to test the effect on long term yield of natural occurrences and silvicultural treatments; to undertake basic research in growth and yield, and in forest inventory methods.
Achievements: Project PI-19 was established in February, 1985, to provide a focus for the modelling activities of the new Forest Management Systems Program. Some previously initiated studies were completed, including the National Forest Biomass Inventory. A contract study demonstrated the potential of airborne pulsed lasers for terrain profiling and estimating tree heights and densities. A study was also undertaken of the relationship between LANDSAT pixel reflectance values and stand volumes. Site index curves for the Northwest Territories were developed for Indian and Northern Affairs

Canada. A comprehensive stand growth model for red pine is nearing completion. Some preliminary work on road network planning was undertaken.

A simple forest management systems model, FORSYS, has been developed that can test the effect on long term yield of natural occurrences and silvicultural treatments. The major thrust of the Project in the future will be to refine this model and integrate it with other forestry models into a forest management decision support system that will be a practical aid to forest managers.

PROJECT PI-20

Technology Development - Forest Insect and Disease Survey (FIDS)

Objectives: To develop and transfer national pest management information and decision-support systems in cooperation with regional FIDS operations. This will include coordination of integrating technologies such as computers, remote sensing, and pest situation modelling.

Achievements: This new project is developing a pest specimen database to analyze four decades of data collected by regional FIDS units. INGRES software is being used for this purpose. The system will be transferable to CFS regional centres for new data input.

A database is also being developed for field measurements collected through the Acid Rain National Early Warning System. It is being cross-referenced to pest specimen data. Collection of national figures on forest pesticide use is also being coordinated by the project.

Investigations are underway to tackle other FIDS data, such as pest infestation information, through geographic information systems.

PROJECT PI-21

Field Services & Forest Management Operations

Objectives: To protect and manage the forest assets of PNFI and CFB Petawawa; to provide timber disposal and forestry advisory services to CFB Petawawa; and, to demonstrate forest management techniques.

Achievements: The project is responsible for managing all timber and forest product sales, ranging from fuelwood operations to clear-cut, for the Institute and CFB Petawawa. Revenue from timber sales have averaged $300,000/year but will be in excess of $500,000 this year due to a large area being cleared for an impact site at CFB Petawawa.

A system to simplify and provide current summaries of timber sales has been implemented and is working well. The system reduces errors in scaling calculations, prepares invoices, and produces timber sale summaries.

The forest management demonstrations on the Headquarters Silvicultural Area (HSA) were maintained and remeasured as required. Visitor interest in this area is increasing.

A contract was let for stand improvement and stand conversion on approximately 86 hectares. This contract will generate $6,000 in direct revenue and rebuild 10.2 kilometers of Institute road.

FOREST GENETICS AND BIOTECHNOLOGY

PROJECT PI-9

Tree Genetics and Breeding

Objectives: To obtain quantitative information on the genetics of tree species used for renewal of Canada's boreal and eastern forests, and to use it to develop, test, and promote the use of strategies for genetic improvement and conservation that will improve the productivity and health of Canada's forests.

Achievements: Research has continued to emphasize the genetics and breeding of the native conifers: jack pine, black and white spruce, and tamarack. Introduced species, such as European and Japanese larch, Norway spruce, and Scots pine, have remained a small, but important, component of the research program.

New data from provenance and progeny tests of different species, planted up to 30 years ago, have reemphasized the importance of adaptive and stand variation related to seed source, and have quantified variation and inheritance of growth, form, wood properties and pest resistance. These data form the basis of publications being prepared and of advice regularly given to public and private agencies.

Measurement and statistical analysis of experiments were completed with increased efficiency using electronic data collection procedures developed at PNFI.

Isoenzyme markers are being increasingly used by the project for clone certification and population studies. Model breeding populations are being created in jack pine and white spruce for advanced-generation research.

PROJECT PI-10

National Tree Seed Centre, Research & Development

Objectives: To improve the quality, quantity, and effective use of tree seed for reforestation and tree improvement in Canada by researching and developing methods of cone crop management, harvesting, handling and processing, evaluating the quality, testing, and treatment and storage of tree seed.

Achievements: The first phase of study on the ecology of seed germination of black spruce and red alder has been almost completed and further experiments will be conducted to determine the effects of pre-chilling and moisture regime. Studies on storage requirements of

white and black spruce seed, and etiology of seed-borne fungi of white spruce and eastern white pine were initiated.

In seed production a research contract report on stimulation of white spruce cone crops with nitrogen fertilizer was completed and submitted to OMNR. A PRUF contract with Professor J.N. Owens of University of Victoria was completed and results published. Some preliminary work to select and test an accelerated seedling growth technique in growth chambers was completed.

In seed protection, results on comparing granular and soil drench applications of carbofuran for control of spruce budworm on black spruce, the control of white spruce cone and seed insects with stem-injected insecticides, and the treating of conelets with conidial spores of *Beauveria bassiana* were reported.

Staff provided technical consulting services to CIDA and other clients.

PROJECT PI-17

National Tree Seed Centre, Seed Bank and Services

Objectives: To provide the national and international forestry community with well-documented seed for research purposes; to provide researchers with facilities and systems for gene resource conservation and seed processing; to provide information on the availability of tree seed and seed management technology; to compile and publish national seed statistics.

Achievements: In response to 89 seed requests in 1984, 809 seed samples of 146 species were dispatched to clients in Canada and 14 other countries. In reply to enquiries, information in the form of letters, reprints, maps, and computer inventory listings was sent to 46 clients in eight provinces and seven countries.

During 1984, a total of 677 seedlots, comprising 95 species, were procured for the seed bank. These were processed by the seed extraction plant and tested in the lab.

The record-keeping system for historical seed test data was improved by implementation of computerized data management programs. Computer files were developed for seed requests, and these have markedly improved the efficiency in filling orders and summarizing statistics.

Data on seed procurement, processing, utilization, and storage were collected from across Canada as part of a second national survey,

and a report summarizing results of the 1980-81 survey was published.

PROJECT PI-11

Soil Microbiology and Fertility

Objectives: To maintain forest site productivity by understanding the influence of intensive management practices on soil microbial processes affecting fertility, and utilizing soil microorganisms and their symbioses with higher plants (biotechnological processes) to maintain soil fertility with minimum use of fertilizers.

Achievements: The project continued to use external contractors (funded by ENFOR & PRUF) to complement growing in-house activities to achieve its goals. The FORCYTE simulation model was refined and associated nutrient and biomass data collected for calibration. Upon completion, FORCYTE-11 will enable the user to analyse the long-term consequences of intensive forest management for a wide variety of production systems.

There was continued collaboration with several universities across Canada in areas such as nutrient cycling, tissue culture of *Alnus*, and harvest/nutrient relationships.

Studies progressed on the impact of whole-tree harvesting on microbial activity, on soil processes and soil animals, rhizosphere N-fixation in several tree species, the isolation and characterization of *Frankia*, evaluaton of different alders, and nutrient removal. Some results were published. Laboratory facilities have been improved. *Frankia* can now be isolated routinely in our labs.

This project is continuing to expand its lab facilities. Future activities will focus on nitrogen-fixing mycorrhizae and associated nutritional implications.

PROJECT PI-18

Molecular Genetics and Plant Tissue Culture

Objectives: To research and study the new technologies of plant cell and tissue culture and molecular genetics, and evaluate their potential for application in forestry.

Achievements: This project was established in April 1985, partially as a new program (Plant Tissue Culture) and partially as a growth of a Biochemical Genetics study in the Tree Genetics and Breeding Project (PI-9).

The principal achievement to date has been the establishment of a world class plant cell and tissue culture facility at the Institute. Cell lines, from pedigreed materials created by the Tree Genetics and Breeding project, have been established for *Picea glauca*, *Picea mariana*, and *Pinus banksiana*. *Betula papyrifera* and *Alnus* spp. cell lines have been transferred from Laval University. These have been used successfully to establish interspecific protoplast fusions. Cell lines have also been initiated in various *Ulmus* spp. which show varying degrees of resistance to Dutch elm disease.

Polymorphic single gene markers, and a modification of paternity analysis, have been used to study mating dynamics in a *Pinus sylvestris* seed orchard and a polycross of *Picea abies* from Norway.

Metabolism of certain key enzymes during seed germination and deterioration has been documented using spectrophotometric and electrophoretic assays.

FORSTATS

The reorganization of Institute programs in 1985 resulted in the disbandment of the Forestry Statistics and Systems Branch (FSSB) and the formation of two programs, FORSTATS and Forestry Data Systems. In addition, some elements of the FSSB research and development program were integrated with Forest Management Systems. The following projects comprise the FORSTATS program.

Forest Inventory

Objectives: To report at five-year intervals on the location and extent of forest lands in Canada, including areas of forest lands, their wood volume, and biomass; to improve and expand the information available on Canada's forests; and, to provide advice and assistance to other federal agencies concerning forest inventories on federal lands.
Achievements: Responded to special client requests for information on Canada's Forest Inventory. The Forest Inventory Program, supported by Forestry Data Systems, can now provide a faster and more efficient response to special requests for national inventory statistics and maps. The project developed draft plans and technical specifications for the delivery of the next (1986) national forest inventory database and also took delivery of Canada's 1984 Forest Biomass Inventory database.

Cooperated with other agencies to develop specifications for forest inventories, deliver a completed inventory and management plan to a Canadian Indian band, develop a prototype computer system to store summary level information on federal forested lands, and revise and computerize the procedures for collection and analysis of statistics on federal timber harvest.

Forestry Change Data

Objectives: To develop the collection, summarization, and national reporting of forestry change data; to establish national standards of change data measurement, including terms and definitions; to assist provincial forest agencies in the development and implementation of change detection and reporting.
Achievements: "Reporting and Summarizing Forestry Change Data - Manitoba Pilot Study" was published as a first step to establish standards of measurement and terminology. Several documents were produced for discussion by the Canadian Forest Inventory Committee (CFIC).

A proposal to assist each province individually in the establishment of forestry change data systems was accepted in principle by the CFS Management Committee in September, 1984. The mechanism for this activity is yet to be established. It was decided that the Change Data program would concentrate on two fronts; the establishment of standards of change data measurement, and promotion of the concept of change data reporting systems through articles, meetings, and workshops.

An internal document, "National Change Data Base - User Specifications and Requirements", was produced as part of the work on a system for national reporting.

FORESTRY DATA SYSTEMS

Forestry Data Systems Program

Objectives: The Forestry Data Systems Program (FDSP) provides the expertise and computer-based services, facilities, and resources in support of the information processing requirements of the various projects undertaken by the Petawawa National Forestry Institute. The primary objective of the FDSP is to provide the Institute with well designed, effective, and cost-efficient information processing technologies, systems, and services.

Achievements: The program provides services to other programs at PNFI and Headquarters. Services provided to research, development, and operation programs during the year included information systems design and development; computer operations consultation, advice, training, and technical support; technology awareness and transfer; and planning and management. Much of the work completed by the FDSP has utilized "state-of-the-art" information processing technologies in the areas of computer-assisted mapping, computer-assisted graphics, geographical information systems, statistical analyses, and database management techniques.

A Digital VAX 11/780 and a PDP 11/44 support the FDSP and its clientele and the software used to manipulate and display data include FORTRAN, SAS, SAS/GRAPH, ARC/INFO, GIMMS, DATATRIEVE, and ALL-IN-1. The VAX computer system is connected to a full line of peripherals including a digitizing station, colour graphics terminals, a colour plotter, various printers, and user terminals.

COMMUNICATIONS

Editing and Publications Services

Objectives: To publish reports and scientific papers which describe the results of research undertaken by the Institute and collected statistics. To promote among the general public an understanding of forest research and sound forest management by preparing and producing a newsletter, leaflets, etc. that describe the work of the Institute. To ensure that the Institute conforms to Federal bilingual requirements.

Achievements: A total of 43 publications were issued by Institute authors in 1984-85. Of these, 19 were Information Reports. Several journal articles and symposium proceedings were also produced.

The AES Multiplus word processing system has proved to be a boon, and the purchase of a 10-megabyte hard disk has enabled the utilization of helpful peripheral software such as the spell check dictionary.

Streamlining of the computerized mailing list continued and the on-site printer facilitated this process.

Information Services

Objectives: To publicize and present activities of the Institute scientific, technical, and education programs to general and special publics; to host visiting delegations; to manage the logistics of varied cooperative ventures with other forestry agencies in keeping with the Canadian Forestry Service mandate.

Achievements: In response to the needs of visiting delegations, Information Services provided the necessary support to ensure efficiency and comfort. Several conferences and symposia were hosted by the Institute, attracting delegates from universities, government agencies, and industry. There were also delegations from China, Malaysia, the Sudan, Iceland, and the Soviet Union.

Media relations were fully developed to include extensive coverage of a number of events and programs. This coverage included television documentary work with national networks.

The 1984 Forestry Capital of Canada celebrations in the Ottawa Valley were largely hosted by the Institute.

Library

Objectives: To provide the staff of PNFI with an efficient and effective library service by supplying reference and current awareness services and by acquiring (on loan or by purchase), cataloguing, and circulating library material.

Achievements: The Library's Policies, Regulations, Guidelines, and Users' Guide were revised as were the Library Committees' Terms of Reference. A proposal to provide on-line literature search services on site at PNFI was accepted. A shelf list was built for the monograph collection and a revised serials list was distributed to users. Eleven Library Accessions Lists were produced and distributed. The library began providing subject access to monographs added to the collection as of April 1984.

Objectives: To promote better management of Canada's forest resources by increasing public awareness of the forest resource and the need for its sound, rational, management through the use of interpretive educational and information projects.

Achievements: Since 1972 a Visitor Centre complex has been developed which is designed to increase public awareness of forests, forestry, and the CFS. A report on the experience of the Centre, plus other aspects of Public Awareness projects, was published during the current year. The forest trail was redesigned with a new theme, storyline, and text.

The local, on-site, portion of the Petawawa Resource Education Project (PREP), a cooperative effort with the Renfrew County Board of Education, was revised extensively to respond to the needs indicated by an impact assessment. Results have been very positive. Work began on the development of a national version of PREP.

A mobile exhibit was constructed for the Ottawa Valley Forestry Capital Promotion Society. This exhibit toured the region all summer.

ADMINISTRATION

Objectives: To provide a financial control system and fiscal accountablility in accordance with statutory and regulatory requirements; to provide general administrative services including purchasing and matériel management, records management, accommodation services, office services, and fleet management; to operate and maintain the physical plant.

Achievements: The physical plant at PNFI includes buildings constructed over five decades. Several renovations were undertaken during the review period to expand wet laboratory facilities and to create more office space. Additionally, one new building was constructed to replace space lost through demolition of old structures. A Master Plan for phased upgrading of the entire physical plant has been completed and will be used in attempts to create better research facilities.

The Office Services section has been modernized and upgraded to handle heavy workloads. Internal stores operations will be upgraded shortly with installation of computerized tracking systems. Also, the motor vehicle garage has been upgraded with modern instrumentation for engine analysis.

EXPENDITURES AND CONTRACTS

PETAWAWA NATIONAL FORESTRY INSTITUTE
EXPENDITURES 1984-1985
($'000)

Program Area	*Person Years*	*Salaries*	*Operations & Maintenance*	*Capital*	*Grants & Contributions*	*Total*
Fire Research and Remote Sensing[1]	33	1,037.4	255.3	63.0	–	1,355.7
Intensive Forest Management[5]	39	1,660.1	732.6	140.8	–	2,533.5
Forestry Statistics and Systems[1]	25	953.2	708.5	713.7	–	2,375.4
Management and Administration[2, 3, 4]	28	1,167.5	1,363.5	391.3	–	2,922.3
TOTAL	125	4,818.2	30,059.9	1,308.8	–	9,186.9

1 Includes computing and technical services.
2 Includes library services.
3 Includes publication and editing services.
4 Includes administrative support services for the Forestry Statistics and Systems Branch.
5 Includes Public Awareness.

SCIENTIFIC CONTRACTS LET OVER $5000, 1984-1985

Contractor	*Supervisor*	*Project Title*	*Amount ($)*
Dr. D.J. McKenney U. of Windsor	Dr. L. Chatarpaul	Study of the impact of intensive forestry on denitrification kinetics in forest soils.	$ 25,797.44
Dr. T.J. Carlton U. of Toronto	Dr. L. Chatarpaul	The calibration of the FORCYTE simulation model for application in central Canada.	102,230.06
Dr. J.J. Balatinecz U. of Toronto	Dr. W.W. Cheliak	Wood quality studies in commercially important conifers.	53,000.65
Dr. J.S. Poland Queen's University	Dr. L. Chatarpaul	A study of the relationships between nutrient levels in hybrid poplar biomass and the nutrient status of soils.	61,175.00
D.A. Johnson U. of Ottawa	Dr. L. Chatarpaul	The possible role of leghaemoglobins of *Alnus* and *Myrica* in nitrogen fixation.	31,570.00
G.L. Austin McGill University	Dr. J. Harrington	Research on the optimum strategy for estimation of rain in remote forest regions.	52,445.00
Dr. J.P. Kimmins U. of British Columbia	Dr. L. Chatarpaul	Coordination of FORCYTE application studies in Alberta and Newfoundland.	16,042.00

CONTRACTS LET (cont.)

Contractor	*Supervisor*	*Project Title*	*Amount ($)*
Dr. J.P. Kimmins U. of British Columbia	Dr. L. Chatarpaul	Refinement, evaluation, and testing of FORCYTE simulation model.	34,890.84
Rhizotec Quebec	Dr. L. Chatarpaul	In vitro development and production of *Alnus* cones.	27,000.00
Dendron Ottawa	Dr. G.M. Bonnor	Study of current research and development needs in forest biomass inventory methodology.	20,000.00
R. Ragbar Toronto	Dr. L. Chatarpaul	Preliminary evaluation of FORCYTE applicable to deciduous coppicing species.	20,005.00
Tomlinson Assoc. Ottawa	R.E. Keen	To provide technical research and advisory services to the Forestry Statistics and Systems Branch.	7,667.59
Dr. J.N. Owens U. of Victoria	H.O. Schooley	The physiology and ecology of tree seed production.	5,500.00
T.M. Thomson Victoria	Dr. G.M. Bonnor	To provide a report on access data for the 1984 National Biomass Inventory.	14,826.79

PUBLICATIONS
1984-1985

Alemdag, I.S. 1984. Total tree and merchantable stem biomass equations for Ontario hardwoods. PI-X-46. 54 p.

Alemdag, I.S. 1984. Wood density variation of 28 tree species from Ontario. PI-X-45. 12 p.

Boyle, T.J.B. 1984. Black spruce genetics, Petawawa National Forestry Institute, 1981-1982. Pages 119-120 *in* Yeatman, C.W., ed. Proc. 19th Meeting, Can. Tree Improv. Assoc., Part 1, Toronto.

Cable, T.T.; Knudson, D.M.; Stewart, D.J. 1984. The economic benefit to visitors of an interpretive facility. J. Environ. Educ. 15: 32-37.

Carlisle, A.; Chatarpaul, L. 1984. Intensive forestry: some socioeconomic and environmental concerns. PI-X-43. 40 p.

Cheliak, W.M.; Dancik, B.P.; Morgan, K.; Yeh, F.C.H.; Strobeck, C. 1985. Temporal variation of the mating system in a natural population of jack pine. Genet. 109: 569-584.

Cheliak, W.M.; Morgan, K.; Dancik, B.P.; Strobeck, C.; Yeh, F.C.H. 1984. Segregation of allozymes in megagametophytes of viable seed from a natural population of jack pine, *Pinus banksiana* Lamb. Theor. Appl. Genet. 69: 145-151.

Cheliak, W.M.; Pitel, J.A. 1984. Biochemical genetics 1981-1983. Pages 121-125 *in* Yeatman, C.W., ed. Proc. 19th Meeting, Can. Tree Improv. Assoc., Part 1, Toronto.

Cheliak, W.M.; Pitel, J.A. 1984. Electrophoretic identification of clones in trembling aspen. Can. J. Forest Res. 14: 740-743.

Cheliak, W.M.; Pitel, J.A. 1984. Techniques for starch gel electrophoresis of enzymes from forest tree species. PI-X-42. 49 p.

Cheliak, W.M.; Pitel, J.A.; Murray, G. 1985. Population structure and the mating system of white spruce. Can. J. Forest Res. 15: 301-308.

Clark, W.R. 1984. L'Appauvrissement des forêts canadiennes causé par les feux de végétation de 1977 à 1981. PI-X-21F. 14 p.

Direction de la statistique forestière et des systèmes. 1984. Présentation et réduction des données sur les changements touchant des forêts: étude pilote au Manitoba. PI-X-36F. 26 p.

Evert, F. 1984. An update (1970/71-82) of the annotated bibliography on initial tree spacing. PI-X-44. 157 p.

Evert, F. 1984. Système national d'équations pour évaluer la masse anhydre du peuplier faux-tremble *Populus tremuloides* Michx. PI-X-24F. 26 p.

Fogal, W.H. 1984. Insect and disease research in tree improvement and seed production - Petawawa, 1981-1982. Pages 126-129 *in* Yeatman, C.W., ed., Proc. 19th Meeting, Can. Tree Improv. Assoc., Part 1, Toronto.

Forestry Statistics and Systems Branch. 1984. Forest harvest on federal lands. PI-X-37. 14 p.

Harrington, J.B. 1984. Solar radiation in a clear-cut strip - a computer algorithm. Agric. Forest Meteorol. 33: 23-39.

Hendrickson, O.; Robinson, J.B.; Chatarpaul, L. 1985. La microbiologie des sols forestiers - revue bibliographique. PI-X-19F. 102 p.

Janas, P.S. 1984. A list of seed in the Canadian Forestry Service Seed Bank/Liste des semences de la Banque de semences du Service canadien des forêts. PI-X-39E/F. 63 p.

Janas, P.S.; Haddon, B.D. 1984. Canadian forest tree seed statistics: 1980-81 survey results. PI-X-41. 23 p.

Kourtz, P. 1984. A network approach to least-cost daily transfers of forest fire control resources. Infor 22: 283-290.

Kourtz, P. 1984. Decision-making for centralized forest fire management. For. Chron. 60: 320-327.

Kourtz, P. 1984. Système de consultation des collections documentaires personnelles. PI-X-31F. 7 p.

Murray, W.G. 1984. Nouvelles exigences, suite à l'élagage dans une plantation, pour la suppression aérienne des incendies. PI-X-26F. 14 p.

Murray, G.; Cheliak, W.M. 1984. Genetics of white spruce, larches, and hardwoods, Petawawa 1981-1983. Pages 130-132 *in* Yeatman, C.W., ed. Proc. 19th Meeting, Can. Tree Improv. Assoc., Part 1, Toronto.

Nieman, T.; Kean, W.; Cheliak, W. 1984. An electronic "notebook" for forestry application. PI-X-38. 44 p.

Normand, P.; Lalonde, M.; Fortin, J.A.; Chatarpaul, L. 1984. The isolation, characterization, and evaluation of *Frankia* strains. PI-X-30. 50 p.

Pitel, J.A.; Cheliak, W.M. 1984. Effect of extraction buffers on characterization of isoenzymes from vegetative tissues of five conifer species: A user's manual. PI-X-34. 64 p.

Pitel, J.A.; Cheliak, W.M.; Wang, B.S.P. 1984. Changes in isoenzyme patterns during imbibition and germination of lodgepole pine (*Pinus contorta* var. *latifolia*). Can. J. Forest Res. 14: 743-746.

Schreier, H.; Longheed, J.; Tucker, C.; Leckie, D. 1985. Automated measurements of terrain reflection and height variations using an airborne infrared laser system. Intl. J. Remote Sensing 6: 101-113.

Slansky, F. Jr.; Fogal, W.H. 1985. Utilization of dry matter and elements by larvae of the sawflies *Neodiprion sertifer* (Geoff.) and *Diprion similis* (Hartig) feeding on Scots pine needles. Can. J. Zool. 63: 506-510.

Springer, E.A.; Van Wagner, C.E. 1984. The seasonal foliar moisture trend of black spruce at Kapuskasing, Ontario. Can. For. Serv. Res. Notes 4: 39-43.

Stechishen, E.; Halicki, G.L. 1984. The Dromader M-18 aircraft: Its role as an air tanker. PI-X-40. 21 p.

Stiell, W.M.; Berry, A.B. 1985. Limiting white pine weevil attacks by side shade. For. Chron. 61: 5-9.

Wang, B S.P. 1984. Overview of utilization of improved seed. Pages 193-200 *in* Yeatman, C.W., ed. Proc. 19th Meeting, Can. Tree Improv. Assoc., Part 1, Toronto.

Wang, B.S.P.; Ackerman, F. 1984. Une nouvelle boîte de germination pour les tests de graines d'arbres. PI-X-27F. 15 p.

Wang, B.S.P.; Janas, P.; Schooley, H.O. 1984. National Tree Seed Centre, 1981-1982. Pages 133-137 *in* Yeatman, C.W., ed. Proc. 19th Meeting, Can. Tree Improv. Assoc., Part 1, Toronto.

Yeatman, C.W. 1984. Global heritage in jeopardy. Pages 1-2 *in* Yeatman, C.W. et al. eds. Proc. AAAS Symp. 87. Plant genetic resources: a conservation imperative.

Yeatman, C.W. 1984. P.N.F.I. genetics and breeding: Genetics of jack pine, 1982-1983. Pages 138-140 *in* Yeatman, C.W., ed. Proc. 19th Meeting, Can. Tree Improv. Assoc., Part 1, Toronto.

Yeatman, C.W. 1984. Production of genetically improved jack pine seed for planting and direct seeding. Pages 171-177 *in* Yeatman, C.W., ed. Proc. 19th Meeting, Can. Tree Improv. Assoc., Part 1, Toronto.

Yeatman, C.W. 1984. Response in Canada of jack pine provenances to *Gremmeniella abietina*. Pages 197-206 *in* Manion, P.D. ed. Scleroderris canker of conifers. Proc. Intl. Symp. on scleroderris canker of conifers, Syracuse, NY, June 1983. W. Junk, The Hague, Netherlands.

Yeatman, C.W. 1984. The genetic basis of jack pine management. Pages 9-13 *in* Proc. Jack Pine Symp., Sault Ste. Marie. COJFRC O-P-12.

PETAWAWA NATIONAL FORESTRY INSTITUTE
CANADIAN FORESTRY SERVICE
CHALK RIVER, ONTARIO

ORGANIZATION AND PROJECT STAFF LISTING
1984-1985

Director	F.C. Pollett B.Sc.,B.A.,M.Sc.,Ph.D.,n.d.c. Secretary: Vacant
Program Directors	R.F. Ackerman B.Sc.F.,M.Sc. J.R. Bryson B.I.S. Hons. R.E. Keen B.Sc.F. J.D. Walker B.Sc. Hons.,M.F.
Administrative Officer	H. Rohde
Personnel Officer	M. Pattison B.A. Clerk: F.I. McCarthy

PROJECTS

FOREST MANAGEMENT SYSTEMS

Program Director	J.D. Walker
Fire Behaviour and Effects (Project PI-4)	C.E. Van Wagner B.Eng.,B.Sc.F. (Project Leader) Gy. Péch B.Sc.F.,M.F.,M.Sc.,M.Ph. Dip.For.Eng. M.G. Weber B.Sc.F.,M.Sc.,Ph.D. J.W. Bell
Fire Equipment and Materials (Project PI-5)	G.S. Ramsey (Study Leader) D.G. Higgins
Fire Management Systems (Project PI-6)	P.H. Kourtz B.Sc.F.,M.Sc.,Ph.D. (Project Leader) B.E. Mroske B.Sc. B.G. Roosen J.B. Todd B.Sc.F.
Fire Suppression Systems (Project PI-7)	E. Stechishen M.Sc.F. (Project Leader) F. Bouillon M. Hobbs W.G. Murray
Forest Meteorology (Project PI-8)	J.B. Harrington B.A.,M.Sc.,Ph.D. (Project Leader) M.D. Flannigan B.Sc. Hons.,M.S. P.J. Litwin
Silviculture and Forest Productivity (Project PI-12)	W.M. Stiell R.P.F.,B.S.F.,M.S. (Project Leader) D.G. Brand R.P.F.,B.Sc.F.,Ph.D. F. Evert M.Sc.F. D.J. McGuire C. Robinson

Digital Remote Sensing (Project PI-16)	D.G. Leckie M.Sc.,Ph.D. A. Dombrowski B.ès.Sc. F. Gougeon M.A.Sc. (on study leave)
Forest Management Modelling (Project PI-19)	R.M. Newnham B.Sc.,M.F.,Ph.D. (Project Leader) I.S. Alemdag For.Eng.,M.F.,Ph.D. M. Bonnor M.Sc.F.,Ph.D. G. Larocque B.Sc.A.,M.ès.Sc. (on study leave) R. Piirvee B.Sc.F.,M.F.
Technology development - Forest Insect and Disease Survey (Project PI-20)	M. Power B.Sc.F. (Project Leader)
Field Services & Forest Operations (Project PI-21)	K. Morrier (Head, Forest Management) C.R.C. Farr B. Mayo R. Urbanski G.J. Yakabuskie (Head, Field Services) D.A. Babinski N. Childs J.C. Germaine E.G. Paquette D.J. Turcotte O.M. Zohr

FOREST GENETICS AND BIOTECHNOLOGY

Program Director	R.F. Ackerman
Tree Genetics and Breeding (Project PI-9)	C.W. Yeatman R.P.F.,Dip.For.,B.Sc.F., M.F.,Ph.D. (Project Leader) T.J.B. Boyle B.Sc. Hons.,Ph.D. S. Magnussen cand. silv.,Ph.D. (Postdoctoral Fellow) G. Murray R.P.F.,M.Sc.,Ph.D. P. Copis B.Sc. B.C. Corbett D.D. Hoelke

	T.G. Nieman B.Sc. W.H. Selkirk J.R. Veen E. Yakabuskie Z. Zdrazil S. Kranz
National Tree Seed Centre, Research & Development (Project PI-10)	B.S.P. Wang B.Sc.F.,M.F. (Project Leader) W.H. Fogal M.A.,Ph.D. R.K. Mittal B.Sc., M.Sc., Ph.D. (Visiting Fellow) H.O. Schooley B.Sc.F.,M.Sc. F. Ackerman M.L. Anderson
National Tree Seed Centre, Seed Bank & Services (Project PI-17)	P.S. Janas B.Sc.F. (Project Leader) E. Gilchrist
Soil Microbiology and Fertility (Project PI-11)	L. Chatarpaul M.S.,Ph.D. (Project Leader) D. Burgess (on study leave) O. Hendrickson M.Sc.,Ph.D. O.L. Clark I.R. Miller R.D. Selby
Molecular Genetics and Plant Tissue Culture	W.M. Cheliak B.Sc.F.,M.Sc.,Ph.D. (Program Manager) F.M. Tremblay M.A.Sc.,Ph.D. S.M. Lopushanski

FORSTATS

Program Director	R.E. Keen
Forest Inventory	J.J. Lowe M.A.,M.Sc.F. (Program Manager) S. Gray B.Sc. Hons. G. Griffith M. Marsan
Forestry Change Data	B.D. Haddon R.P.F.,B.Sc.F. (Project Leader) W.R. Clark

FORESTRY DATA SYSTEMS

Program Director	J.R. Bryson
	T. Moore B.Sc.F. L. O'Brien B.Sc. Hons. T. Pickett G. Campbell D. Dilabbio W. Harris W. Kean E. Leskie E. Trottier

COMMUNICATIONS

Program Director	R.E. Keen
Editing and Publications Services	A.C. Yapa B.Sc. Hons.,B.A. (Project Leader) B. Ballantyne B.A.,B.Ed. E.F. Andersen
Information Services	D. Lemkay (Project Leader)
Library	M. Mitchell B.A.Sc.,M.L.S. (Project Leader) C. Pensom
Public Awareness	D.A. Stewart R.P.F.,B.Sc.F. (Project Leader) J.J. Williams R.E. Davies

ADMINISTRATION

Administrative Officer	H. Rohde
Finance Officer	J. McManus
Accounts Clerks	P. Swan
	L.E. Johnston
Registry/Reception Clerk	A. Miller
Procurement Officer	W.W. Levasseur
Storeman	R.J. Hynes
Driver/Messenger	D. James
Text Processors	C.J. Lachance (Supervisor)
	J.P. Moreau
Engineer	K. Krumins B.Sc.
Stationery engineers	E.E. Grieve
	C.E. Wilson
Tradesman Supervisor	C. Lapierre
Municipal Services Tradesman	D.C. Houde
Mechanical Maintenance Supervisor	L. Lussier
Mechanics	K. Griffith
	R. Gohr

PNFI ORGANIZATION CHART